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RESEARCH IN ENGINEERING[1]

By Sir ALEXANDER GIBB, G.B.E., C.B., F.R.S.

Engineering started as an art; at a later stage it developed into a somewhat scientific but purely empirical practice; it is now the final stage of applied science.

That engineering is a science has not always—and still in some quarters is not—recognized or appreciated, even among engineers themselves. For that we have no one to blame but ourselves. Too long were we content to act by the light of accumulated experience, not always fully assimilated. But engineering has now for some time past realized that, without research, progress and improvement are impossible.

Engineers have sooner or later always made use of the discoveries of science; but the connection with science has been casual and haphazard. "It seems exceedingly doubtful if Watt or any other inventor," wrote Professor Lea, "would have thought of the independent condenser, if it had not been for the fundamental work of a purely scientific character done by Toricelli, Boyle and others, on the pressure of the atmosphere, and that by Black and Watt which led to the discovery of the latent heat of fluids, and thus to a quantitative appreciation of the heat units involved in changing water into steam."

But organized research was then something still unknown. For the first fifty years of its life the Royal Society had to bear the jeers and sneers of the pulpit, the platform and the literary world. When Harvey published his tract describing the circulation of the blood it was received with ridicule, as the utterance of a crack-brained impostor, and he was deserted by almost all his friends. This attitude of distrust on the part of the public lasted into the nineteenth century. But scientific research was at last becoming a matter not only for the individual crank and dilettante, but for scientific cooperation. The encouragement of research and the advancement of useful knowledge were

[1] Address of the president of Section G—Engineering, British Association for the Advancement of Science, Nottingham, September 2, 1937.

indeed among the objects of the foundation of the Institution of Civil Engineers in 1818.

It may be interesting at this stage to remind ourselves very briefly of the history of research, and how very recent is its growth.

The Royal Commission, appointed to administer the surplus of £213,000 made by the Great Exhibition of 1851, used the money to purchase a large piece of land in Kensington Gore, on which are built the South Kensington Museum, Schools of Science and Art, the Natural History Museum, the Museum of Scientific Instruments and others that I need not mention. In addition to this many science scholarships have been provided.

From 1850 the government gave an annual grant of £1,000 (increased by £4,000 a year in 1877) to the Royal Society for the promotion of scientific inquiries, which went to aid research in mathematics, physics, astronomy, biology, chemistry and general purposes. The society also benefited from many donations from its own fellows. And from time to time private individuals, by donations or bequests, endowed fellowships.

But in Great Britain original research continued to be mainly the task of individual scientists, chiefly at their own expense. Industry had certainly not yet recognized its value, and it was to be a full generation before it was fully and practically accepted that scientific and industrial research is an essential factor in our industrial and national existence.

In Germany greater progress had been made. The lessons learned in the Franco-Prussian War led to the institution in 1872 of the Reichsanstalt and the Materials Testing Department. The former was established in two divisions—the one devoted to pure science and the other to its application to the advancement of industry and manufacture. At the same time technical colleges for research and the training of research students were founded at Charlottenburg, Darmstadt and other centers. German industrialists quickly recognized the value of the work of these institutions. The A.E.G., Siemens and Halske and such great companies at an early date set up private research laboratories. The development of the dye industry is a perpetual warning and incitement, for it was Perkin who first discovered, in 1857, the manufacture of aniline blue; but it was left to the Dye Company of Germany to create from his discovery the great German dye industry, for which purpose huge sums were spent in developing new methods and evolving new dyes.

To return to our own country and engineering. In 1893 Sir William Anderson wrote: "The days are past when the engineer can acquit himself respectably by the aid of mother wit alone or of those constructive instincts, which in the past led our predecessors to such brilliant results." Four years later the government appointed a committee under the chairmanship of Lord Rayleigh to consider and report upon the desirability of founding a National Physical Laboratory. The setting up of this committee was incidentally largely due to the agitation, led by Sir Oliver Lodge, at meetings of the British Association and elsewhere.

In 1898 Lord Rayleigh's committee issued its report, recommending that a public institution should be founded "for the standardizing and verifying of instruments, for testing materials and for the determination of physical constants," and that it should be under the control of the Royal Society. The scheme was drawn up in 1899 and Dr. Glazebrook, F.R.S. (afterwards Sir Richard Glazebrook) was appointed its first director, a position which he held until 1918.

The year 1900 is, too, an important dividing line in another sense. The National Physical Laboratory was founded just before it; and two years after it, 1902, the British Engineering Standards Association was established, by the cooperation of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institute of Naval Architects and the Iron and Steel Institute, under the chairmanship of Sir John Wolfe Barry, the great civil engineer. Since 1900 research has been on the whole recognized as a question of national importance.

The history of the National Physical Laboratory has been one of continual expansion. From Kew it removed immediately to Teddington to have greater space. In 1901 the Engineering Laboratory was completed. In quick succession followed departments dealing with electrotechnics, electrical standards, optics, thermometry, pyrometry, tide-predicting, road material, physics, metallurgy, aeronautics, ship model testing, to mention only a few of its manifold activities. By 1918 when it became part of the larger organization known as the Department of Scientific and Industrial Research, it had already an expert staff of 600. It has now over 1,900.

The original committee of eight, under the chairmanship of Sir John Wolfe Barry, that controlled the British Engineering Standards Association has now expanded into a body of 870 committees with 4,850 members.

In later years, coordination has become recognized as essential. "In any earlier age," said Mr. Thomas Midgley, on the occasion of the award to him this year of the Perkin Medal of the Society of Chemical Industry, "when science and industry were simple individualistic processes, it is conceivable that some person, by his efforts alone, could have advanced applied chemistry to have justified your committee to bestow upon him the Perkin Medal. To-day this is no longer so. To advance applied chemistry even a little requires the organized efforts of many individuals. Since you

have chosen me as the recipient of the Perkin Medal for 1937 it is only fitting that I acknowledge at this time the aid which I have received from others in solving the two problems for which you are rewarding me." Such ascription of merit would have to be made by every research worker of to-day.

The same is true generally in industry and manufacture. Every important industry and many manufacturers devote considerable expenditure to research. It is in fact the only means of continuous progress in an increasingly competitive world. It is almost the exception now to find a firm of any standing that has not its research department, and some of the most extensive and elaborate laboratories in the country are under the control of great manufacturing firms. The modern state is founded on scientific research—not like the French judge in 1794, who, in sentencing to death Lavoisier, one of the founders of modern chemistry, said that the Republic has no need of scientists!

Nowadays a vast amount of state-aided research is being carried out by state departments, private research laboratories, research associations, scientific institutions, universities and technical colleges and still by private individuals.

The engineering world has not kept pace with the scientific world; and it has been fortunate that the two distinguished directors who administered the activities of the National Physical Laboratory for the first thirty years of its existence, Sir Richard Glazebrook and Sir Joseph Petavel, should have been men of the widest views. Before 1914 the work of the National Physical Laboratory was very valuable, but during the war, it became indispensable both to government and to industry. In due course it was found that a wider organization was wanted to link in a more definite way the relation between science and engineering research and industry. A Joint Board of Scientific Societies formed a deputation under the leadership of Sir Joseph J. Thomson to stress the importance and urgency of the question on the government.

The outcome was the establishment, in 1915, of the Department of Scientific and Industrial Research, under the control of a Committee of the Privy Council, with an Advisory Council of scientific men of the highest rank in the country; and in 1918 the National Physical Laboratory became part of the newly created department, though the Royal Society continued to control its scientific activities.

A glance at the summary of the latest report of the Department of Scientific and Industrial Research affords some idea of the immense engineering field it now covers in its work. It includes fuel research, food investigation, building research, steel structures, roads, road tar, forest products research, researches on water pollution, metallurgy and radio, chemical research, illumination, lubrication, atmospheric pollution, furnace design, industrial respirators, radium beam therapy, x-ray analysis, and I may add, almost any problem you may like to put before them.

But apart from the immense importance of the scientific work done, the department is the focus for linking together all the research going on in the country. This it made from the outset one of its primary objects; and one of the chief ways in which it accomplishes this is by the encouragement of the formation of research associations. These associations are self-governing bodies formed on a national basis in various industries for research in the interest of the industries they serve. Each association is, or aims at being, a cooperative unit representing all the firms who belong to that particular industry. There is no fixed subscription, it being based on the size of each firm, so that for a very small sum a small firm may have the benefits of an organization which is spending thousands of pounds annually on fundamental research of interest to the whole industry. The associations work in close contact with the Department of Scientific and Industrial Research, to which each one submits a yearly report of the work it has done and the problems which it is studying. The department's help does not, however, stop at this point. In addition to advice and technical help, it contributes to the funds of the research associations by making a £1 for £1 addition for every sum provided by the members.

Of equal importance is the work carried on in the various research bodies under the management of the great scientific institutions. These again are largely cooperative in their aim. Some, indeed, as for instance the Research and Standardization Committee of the Institution of Automobile Engineers, are affiliated to the Department of Scientific and Industrial Research as research associations, and receive the department's £1 for £1 contribution to their funds.

Nearly all the universities now have research departments, which not only carry out practical work of importance, but also act as training centers for students who are to make research work their livelihood; while as already mentioned private research laboratories are maintained by the more important and wealthier firms—as well as by quite humble businesses. Their primary object is naturally the furthering of private interests, but they are not entirely isolated units. Many such research departments belong to one or other of the research associations and frequently pass on problems of a fundamental nature to them to deal with. All can work in contact and correspondence with the Department of Scientific and Industrial Research—if they desire.

I have tried to indicate the rise, growth and present

state of research in this country. Some idea of the recency of its growth may be gained from the fact that in the eleventh edition of the Encyclopedia Britannica, published in 1910, the subject receives rather less than half a paragraph.

The early years of the twentieth century saw on the whole much greater research activity abroad and in America than here. It is quite impossible to enter on any account of these, but I might mention that the National Academy of Sciences was founded in the United States as early as 1863, to deal with all phases of national research; and its influence in the United States is comparable to that of the Royal Society in our own country. In 1916 the academy created the National Research Council to assist the government in organizing the scientific resources of the country, which proved of such great service during the period of the great war that it was decided to maintain it as a permanent organization. One of its main branches was that of engineering and industrial research.

The first years of the new century, also as with us, saw the setting up of the National Bureau of Standards by the United States Government, which covers an immense field and whose technical bulletins and other publications are the means of making widely known many of the latest scientific discoveries. America has indeed always been forward in promoting international standardization in engineering and cooperation in research work, considering that the two matters must run together—as is so. The Bureau of Standards includes as part of its organization a close cooperation with the research department of the universities and other institutions in every state.

In America, too, industry and manufacture have taken a leading part in the research movement, and some of their great laboratories eclipse our own in size. The United States have developed a form of cooperative research of their own, of which the Mellon Institute is the best known example, founded in 1913 by the brothers Richard and Andrew Mellon. Since its origin 1,150 research fellowships have been established in 275 technological subjects and 650 processes or products have been invented or developed. In ten instances new industries have resulted.

In Canada, where I was very recently, I was greatly struck by the action the Dominion Government is taking in the promotion of research. The National Research Council, with headquarters at Ottawa, where it has a magnificent new building, is not only carrying out a very wide program of practical research, but is aiming at training a big body of research-minded engineers and scientists.

One could continue the story of research abroad, but I must stop. I have omitted much that those acquainted with the subject would have expected to be included. But I have done enough to show what a great deal has been done to establish research in our generation.

There is no finality. Every day extends the bounds of knowledge. We have only just begun to understand how to conduct organized research. "The historian of the future," writes Lord Rutherford, in the last Report of the Department of Scientific and Industrial Research, "will probably point to the last five years as a period marking an important development in the industrial outlook of this country. These years have witnessed the fruition of the policy adopted by several large industrial undertakings of setting well-balanced teams of research workers, including chemists, physicists, engineers and where necessary biologists, to solve a particular problem or to develop a new product. This method of attack has led to the steady improvement of the efficiency of electric lamps, to the position this country has won in high definition television, to the development on a commercial scale of the huge plant for the conversion of coal into oil by hydrogenation, to the growth of the plastics industry and to many other important advances. . . . Cooperation can never win the fullest success until the contacts between men of ideas in industry and men of ideas in science are as closely knit as possible."

Although I have dealt so briefly with the subject I hope I have made evident that research divides itself into several categories. It is, I think, very necessary to bear this in mind.

There is what one may call true fundamental research—splitting the atom, or extreme low temperature investigation. No one can doubt that the results will ultimately have their effect on human life. No one, however, can now say who will be benefited, or how. Such work must always be expensive, it must depend on endowments and generous gifts. It is not with this type of research that engineering is directly concerned.

I am concerned with applied research, and it has its divisions. We have in the first instance work of more or less universal application—such as agricultural research, the breeding of new wheats or methods of storage of fresh fruits; or investigations in regard to river pollution. The results once attained become immediately available to all the world. Such work too depends on endowments and government support. This type of research, as fundamental research, often finds its home in our universities, and where there is still opportunity of individualism.

Then there is the research that deals wholly with the problems of a particular industry—aircraft building, or the development of welding. Here the whole work has a much more restricted field and definite goal. New truths are not sought; but the means of

turning the inventions of others to practical use and the economic solutions of the problems of those concerned in the particular industry, whatever it may be. The results can be more or less restricted to the members of the industry that support the research, and the admitted object is to benefit those members.

The Mellon Institute in the United States typifies a rather different type of coordinated research. The institute has a limited membership. Only one representative of each class of interest is admitted. For instance, there is only one yeast firm that is a member. No other would be able to become a member. But of course the boundaries of the interests of many member firms necessarily overlap. The result is that while applied research is being carried on in many different fields in the Mellon Institute, all the members may benefit sooner or later from researches into problems not directly connected with them. The institute is extremely ably run. The results have been considerable, and private research is enabled to be carried out on a broader basis than would otherwise be possible.

Finally there is the private research department, large or small, of every progressive company. Here while the results can be kept entirely confidential, obviously the scope is in some ways more restricted. Most companies find it necessary to pool inventions, and even so where research is carried on more or less in secret, there is danger that errors of approach may not be realized, until much damage has been done or time lost.

With these remarks, I turn to the all-important question of finance. Research is expensive. Who is to pay? In the early days of discovery it was inevitably at the expense of the individual, and in this way many private fortunes were spent for the ultimate good of industry and humanity.

In the nineteenth century, apart from the scientists who spent their private fortunes, research was largely dependent on the endowment of public-spirited benefactors, and to scientific societies. Government, as I have already said, more far-seeing than the general public and in spite of futile criticism, began to aid in a small way from the middle of the century onwards. Generally speaking, industry had not realized the importance of research and its attitude was almost hostile until the twentieth century was well on its way. The £54,000 raised for the Ramsey Memorial Fellowships, after his death in 1916; Sir Alfred Yarrow's £100,000 in 1923, are earlier examples of the efforts of individuals which have their modern counterparts in Lord Austin's and Lord Nuffield's gifts to Oxford and Cambridge Universities.

But it is now sufficiently admitted that research should be paid for by those who benefit by it—the community and industry. The attitude of industry has changed from indifference to support. "It is not easy to assess over a period of twelve months the change that is taking place," writes Lord Rutherford in the report I have already quoted. "Comparison of the attitude of to-day with that of ten years ago indicates more definitely what is happening. In one field of our work industry affords each year clear and tangible evidence that the forward movement which it has been our aim to encourage is gathering momentum. The steady increase in the total sum which industry as a whole provides annually for the development of research associations gives us good reasons for taking an optimistic point of view."

In the year 1932–33 a total sum of £167,370 was supplied by all the industries concerned for the support of the research associations organized by them. In 1935–36 the figure had grown to £232,468—an increase of 40 per cent. in three years. But even so the position is not yet satisfactory, and industry still lags behind in its support of these associations, in spite of the liberal encouragement of government. I have no doubt, however, that this stage of affairs will not last. In the past year several important steps forward have for instance been taken—the opening of the splendid new laboratories of the Printing and Allied Trades Association, the Perivale Laboratories of the Electrical Research Association, the new laboratories of the Research and Standardization Committee of the Institution of Automobile Engineers, the extensions to the Shirley Institute and the Research Station of the Paint Research Association at Teddington.

We have been experiencing a revival, and hopes are high again. This always makes it easier to get money. Unfortunately, when industry is depressed, and when research is all the more necessary, the necessary support is not forthcoming. I might instance the William Froude Laboratory. The work of the institution was made possible by the benefactions of two leading members of the ship-building industry, Sir Alfred Yarrow in its early days and Sir James Lithgow in its more recent developments. The maintenance of the research work, however, depends largely upon its provision of funds by the shipping and shipbuilding industries. Actually, the major portion of the expenditure has been met by payments for tests by individual members, while the industry as a whole has contributed only about £2,000 a year, an inadequate sum to deal with the immense field that has to be covered. In the years 1935–36, 73 ship designs involving the making and testing of 160 model hulls were dealt with. Four of the designs were improved in hull and propeller by more than 20 per cent., and effective improvements were made in 54 out of the 73 designs. "It has been calculated," we are told, "that if only one ship were built to each of the im-

proved designs resulting from one year's work at the Tank, the annual saving in the cost of operating the vessels would be more than enough to cover the cost of running the William Froude Laboratory for a year."

Of course, here as always in research, it is the case that the greater the success of research, the more immediate and drastic the effect on existing plant and equipment. That is where the rub sometimes lies. Millions are necessarily sunk in fixed assets which may in a year or two be made obsolete by the development of new methods. Obsolescence is indeed so rapid nowadays that it is not unusual for new plant to be written off in four years; and many valuable inventions have been bought up by vested interests and suppressed in order to save the greater loss that their exploitation would involve to already operating plant. It is therefore not surprising that there is not always an enthusiasm for unrestricted research or a readiness to praise it. But it is a shortsighted policy.

I have glanced at the rise and growth of the modern research movement. Coordination and cooperation have done much to link together the various elements, but there has as yet been no general national plan. For totalitarian states such things are not so difficult; but for that reason democratic countries too must organize and cooperate more closely than ever before. Groups of unrelated, often competitive, bodies can not be really effective. In my opinion the time must come when every research organization will be linked by some form of affiliation to a central controlling body. This would become inevitable in time if only to prevent hopeless overlapping and duplication, with attendant waste of energy, time and money. There is another direction where centralization is equally necessary. I refer to publication. At present if the results of research are not kept as trade secrets, they are often broadcast in such a multitude of journals, books, papers, addresses, etc., that it is almost impossible for one who is studying any particular branch to avoid unwittingly covering ground already covered by previous workers. We have all experienced the difficulty of trying to collect all the latest information on the subject we have been called upon to deal with. I believe that approximately thirty thousand scientific periodicals are published throughout the world, each of which no doubt may contain the results of research in some form or other. In our own country no definite and practical scheme has yet been conceived for making available the results of research. There should, moreover, be some type of clearing-house of engineering information, such as would collect, collate and make immediately available all new data discovered. Some partial success has been attained in this direction in more than one way. The Executive Council of Imperial Agricultural Bureaux, for instance, an autonomous authority that deals with the finance and administration of ten scientific bureaus, works in close touch not only with all the councils but with other research centers such as the Low Temperature Research Station at Cambridge, the Building Research Station at Watford, and so on. If it be impossible even to work out a similar organization for engineering on a national or world-wide basis, it can not be impossible to establish at least a clearing-house system at a relatively small expense in cooperation with the Department of Scientific and Industrial Research. This department, with the research associations which it partly finances and others with which it is associated, provides the ideal nucleus for such an information service, but engineering must work out its own scheme.

I am afraid I have no definite proposals to make—at least at this juncture. All I have desired to do is to ventilate a subject of paramount importance to engineering. I would thank you for so courteously listening to me; there is no more useful work that the British Association does than offer opportunities for the ventilating of the vital problems and questions of the day. I am satisfied that at the moment in the engineering world—which after all means in the whole commonwealth—there are two outstanding questions, the coordination of effort and the promotion of intensive research.

SCIENTIFIC EVENTS

ADDITIONS TO THE COLLECTIONS OF THE NATURAL HISTORY MUSEUM, SOUTH KENSINGTON

THE London *Times* records that the Natural History Museum, South Kensington, has received as a gift from J. L. Chaworth-Musters the collections made by him in the early part of this year in the High Atlas Mountains, above Marakesh. The specimens include a few small mammals and 82 birds belonging to 31 species.

Among the birds are the rare crimson-winged finch, an Alpine accentor and local forms of the dipper and shore lark. Mr. Chaworth-Musters also brought back 391 carefully preserved specimens of plants, which he has given to the Department of Botany. Of these five are ferns, 28 lichens and the remainder flowering plants.

Major W. R. Barker, of the Game Preservation Department, Khartoum, has presented a young female white rhinoceros and the skin and skeleton of an antbear, and the Rowland Ward Trustees have given a number of mounted heads of mammals. A collection

of marsupials, including some rare species, from Fergusson Island, New Guinea, has been purchased.

The Entomological Department has been given by Charles Dru Drury a number of interesting papers relating to his ancestor, Dru Drury (1725–1803), who was famous for his collections and descriptions of insects.

Among additions to the Mineral Department is a nugget of osmiridium, weighing nearly an ounce, from Adamsfield, near the source of the Derwent, in Tasmania. Osmiridium is an ore of iridium (which is used for the tips of fountain pens, among other things) mixed with osmium. The museum already possesses a rather bigger nugget, reputed to be the second largest in the world, but that now acquired is better crystallized. Another important purchase is a slice, weighing 1,387 grams, of a rare stony-iron type of meteorite known as a pallasite, from Springwater, Saskatchewan. Of historical interest is a selection of minerals from the collection of Wilhelm Karl von Haidinger, who from 1823 to 1826 worked in Edinburgh with Thomas Allan, a celebrated Scottish mineralogist, whose collections are at South Kensington.

A. W. G. Kingsbury, who has recently been collecting in the Mendips, has rediscovered the locality for pyromorphite, a lead phosphate, which was known there in the eighteenth century. He has presented a specimen of this to the museum, as well as a fine large piece of the rare lead oxychloride known as Mendipite. To the Department of Geology a collection of nearly 200 fossil fruits and seeds from the Cromer forest bed, all described by Mrs. E. M. Reid and her husband, the late Dr. Clement Reid, has been given by Mrs. Reid.

MATERIAL REWARDS FOR SCIENTIFIC RESEARCH

The British Medical Journal calls attention to a resolution recently passed by the French Academy of Medicine advocating the legal protection of ideas as well as their applications. The *Journal* writes:

On June 8 one more step was taken in the direction of giving scientists material rewards for their discoveries when the French Academy of Medicine passed a resolution in favor of this principle. During the past decade this problem has appeared from time to time on the agenda of scientific and allied bodies, including the League of Nations and its offspring the International Institute of Intellectual Cooperation. In a report presented on behalf of the Commission of Intellectual Cooperation, Bergson maintained that in the scientific field a new idea, not only its application, deserved protection on behalf of its author. Last March a study of the rights of savants was presented to the Academy of Medicine by Paul Olagnier. The commission, which was appointed by the Academy, and which was composed of some of its most distinguished members, has now issued its report, and it was as a response to this report that the Academy on June 8 unanimously voted a resolution in which the Government was invited to submit to Parliament the draft of a law aiming at the preservation of the rights, moral and material, of savants and inventors in all the fields in which their discoveries and scientific inventions exist. In the preamble to this resolution it was noted that legislation as it now stands does not grant to savants the same rights with regard to their discoveries and inventions as those enjoyed by the authors of literary and artistic works. It has seemed for some time that the discussion of this subject by learned societies has inevitably been doomed to the futility of pious wishes lacking executive expression; but what has given rise to hopes that this problem may be transferred from the academic to the legislative plane is that the French Government has prepared the draft of a law amplifying and harmonizing already existing legislation concerning authors' rights. With good will it ought not to be difficult to couple these proposed reforms with clauses extending the rights of authors to scientists in Bergson's spirit.

THE MUSEUM OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

A MUSEUM of the industrial arts and sciences is under development at the Massachusetts Institute of Technology. Instead of being housed in a separate building, it is divided into many units, scattered through the three miles of corridor and utilizing various foyers and stairwells. The reason for this arrangement is that each department is to have its own exhibits in its own domain, and under its own immediate supervision. A central committee, under Professor Edwin S. Burdell, professor of sociology and dean of the newly created Division of Humanities, is correlating the departmental programs.

It is expected that future growth will come to a large extent from the initiative and enthusiasm of the staff and the student body, and that cooperation will come from the alumni. A museum is visualized which will be of benefit to student and general public alike, and which will show not only the activities of the school but also the great movements in science and engineering that have affected and are affecting the social destinies of mankind. The committee has as its ideal this accent upon the connection between science and the individual—a connection which is becoming more and more appreciated, but by no means clearly understood.

Though the institute's charter in 1861 made provision for a museum, it was not until 1920, when the department of naval architecture and marine engineering was opened, that anything resembling a museum came into being. That department was created by the bequest of Charles Herbert Pratt, which stipulated a

marine museum. The marine collections grew rapidly under Professor James R. Jack, for many years head of the department. The large print and model collection of Captain Arthur Clark, one of the finest collections of its kind, was acquired by bequest; also, from the Navy Department, a series of models representing the evolution of the United States Navy. Professor Jack himself has made five models of ships of prime importance in American history. Arrangements are now being made for receiving as a loan exhibit the large print collection of Henry P. Kendall, depicting the whaling industry.

Other exhibits either installed or in process of preparation are: specimens showing the evolution of the telephone; other specimens showing the evolution of the vacuum tube; a series of models representing problems in descriptive geometry; an exhibit for technology's work in meteorology; a large model of a cracking unit; a workable model of a gas plant; numerous exhibits in physics and chemistry. In addition, the equipment in the many large laboratories is being labelled for the benefit of the visitor.

THE NATIONAL SEASHORE PARK IN NORTH CAROLINA

According to an account printed in *The Christian Science Monitor,* establishment of the first national seashore park has been authorized by Congress.

The proposed park will embrace approximately 100 square miles on the North Carolina seacoast. It will include Cape Hatteras and its historic lighthouse.

The national seashore will be developed in the same manner as national parks. The law provides that all land must be deeded to the United States through public or private donation. No federal purchase of land is permitted. When 10,000 acres have been accepted, federal administration will begin.

Approximately 7,540 acres are already in government hands, including 1,400 acres comprising Cape Hatteras State Park, 44 acres surrounding the lighthouse, 96 acres at Kitty Hawk and 6,000 acres controlled by the U. S. Biological Survey.

The North Carolina area was chosen for the new park both because of its historic associations and its unspoiled natural beauty. Three and a half centuries ago, Sir Walter Raleigh's colony was established on Roanoke Island, one of a chain to be included in the park area. In that colony was born Virginia Dare, the first white child of English parentage born on the North American continent.

Recently the State of North Carolina with the aid of WPA funds has restored the "lost colony" on Roanoke Island. In addition to the birthplace of Virginia Dare, there is a log church, a fort and several thatched log cabins, all surrounded by a log stockade. Surrounding fields have been sown as the colonists sowed them, with squash, pumpkin and maize.

According to reliable records, the colony's governor set sail for England in August, 1587, to get relief for his settlers and when he returned two years later, there was not a trace of any one.

The Cape Hatteras area has never been developed. Its glistening beaches, stretching for miles, are marked only with rotting hulls of wrecked ships. A lighthouse built in 1868 will be preserved as a feature of the national seashore.

In recent months, considerable work has been done with relief labor to stop erosion along the beach. Brush fences were installed causing sand dunes to be built up by the wind. When the dunes are sufficiently high, grass is planted to anchor the sand.

Cape Hatteras and Pamlico Sound form one of the greatest hereditary wintering areas for waterfowl on the eastern seaboard. Ducks, Canada geese, snow geese and whistling swans are found in large numbers in fresh water ponds, brackish marshes, tidal estuaries and other waters along the cape during the winter months. In the spring and summer there are colonies of nesting little blue herons, eastern green herons, terns and many other birds requiring the type of habitats found along Cape Hatteras.

GRANTS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE IN AID OF RESEARCH

Each year the association, upon recommendation of the Committee on Grants, makes grants to individuals in aid of research. Applications for these grants must be in the hands of the committee on or before October 30, and the grants are awarded at the annual meeting of the association in December.

The present members of the committee, the sciences which they represent and the years in which their terms expire are as follows:

Arthur H. Compton (physics, 1937), the University of Chicago; C. C. Little (zoology, 1937), Jackson Memorial Laboratory; Moses Gomberg (chemistry, 1938), the University of Michigan; McKeen Cattell (medicine, 1938), Cornell University Medical College; Joel Stebbins (astronomy, 1939), the University of Wisconsin; Sam F. Trelease (botany, 1939), Columbia University; J. G. Lipman (agriculture, 1930), Rutgers University; A. T. Poffenberger (psychology, 1940), Columbia University.

Applicants for grants are requested to address all correspondence respecting their applications to the permanent secretary, the Smithsonian Institution Building, Washington, D. C.

Since the income of the association available for grants is limited, it has been the practice to make small grants to assist in the completion of research which may be expected to be finished within a year rather than to support large projects. The association does not make grants for the publication of reports of research.

Blanks for the filing of applications for grants can be secured from the office of the permanent secretary. Each application should describe clearly the nature of the project for which support is sought, the state to which it has been carried, the use to be made of the money for which application is made and the estimated date of completion of the work. Each application should be accompanied by letters from at least two competent scientists respecting both the project and the applicant. It is important that applicants give careful attention to these requirements. Instructions will be furnished to those to whom grants are awarded respecting acknowledgments of aid, reports of progress and the filing of publications of results.

RECENT DEATHS

Professor Herman Diederichs, dean of the School of Engineering at Cornell University, died on August 31 at the age of sixty-three years.

Dr. David Hendricks Bergey, formerly professor of bacteriology and hygiene at the University of Pennsylvania, died on September 5. He was seventy-six years old.

Dr. Henry H. Collins, since 1920 professor of biology at the University of Pittsburgh, died on August 31 at the age of fifty-two years.

Dr. Arthur Bruckner, head of the department of mechanical engineering at the College of the City of New York, died on August 29 at the age of sixty-five years.

Dr. George H. Simmons, general secretary of the American Medical Association from 1899 to 1911 and editor of the *Journal* of the association from 1899 to 1924, died on September 1 at the age of eighty-five years.

Eugene Merz, consulting expert of the Calco Chemical Company, died on September 5 at the age of sixty-eight years.

John M. Alden, supervisor of oil and gas operations of the U. S. Geological Survey, Tulsa, Okla., died on August 16 after a brief illness. Mr. Alden entered the federal service as associate natural gas engineer in 1921 and in 1930 became supervisor of the Mid-Continent District, where he directed oil and gas operations on public and Indian lands in Oklahoma, Louisiana and New Mexico.

Dr. Richard Philip Baker, associate professor of mathematics at the University of Iowa and a member of convocation of the University of London, died on August 13 at the age of seventy-one years.

Professor Magnus MacLean, professor emeritus of electrical engineering at the Royal Technical College of Glasgow, who in his earlier career was associated with the late Lord Kelvin in connection with the laying of the transatlantic cables, died on September 2 at the age of eighty years.

SCIENTIFIC NOTES AND NEWS

An honorary doctorate has been conferred by the University of Copenhagen on Dr. August Krogh, professor of comparative physiology in the medical school.

The Austrian insignia for science and art have been conferred on Professor Hans Molisch, vice-president of the Vienna Academy of Sciences; Dr. Julius Wagner-Jauregg, emeritus professor of psychiatry at Vienna; Dr. Hans Horst Meyer, emeritus professor of pharmacology at Vienna; Dr. Otto Loewi, professor of pharmacology at Graz, and Dr. Viktor Hess, professor of experimental physics at Innsbrück.

Dr. Max Neuburger, professor of medical history at Vienna, has been elected an honorary member of the American Association of the History of Medicine.

Dr. Georges Duhamel, member of the French Academy and editor of the *Mercure de France*, has been elected a member of the French Academy of Medicine in place of the late Dr. Legendre.

At the recent centenary of the University of Athens, Greece, the degree of doctor *honoris causa* was conferred upon Dr. Carl Murchison, formerly professor of psychology at Clark University and now editor of the various psychological journals published by The Journal Press at Provincetown.

At the commencement exercises of Kalamazoo College the degree of doctor of science was conferred on Dr. Frederick W. Heyl, director of chemical research of the Upjohn Pharmaceutical Company, Kalamazoo, Mich.

Gustave W. Thompson, chief chemist of the National Lead Company, has been elected to honorary membership in the American Society for Testing Materials as "an international authority on lead and its uses, who has probably done more than any other living man to develop the scientific and technical aspects of the lead industry."

Dr. I. Michael Lerner, instructor in poultry husbandry in the College of Agriculture of the University of California, has been awarded the Poultry Science Research Prize for 1937 for his work on relative growth and hereditary size limitation in the domestic fowl.

This award of $100 is given annually to a member of the Poultry Science Association "presenting the most noteworthy paper published during the past year on research using poultry as the experimental animal."

To perpetuate and extend the scientific research work done by Dr. George Washington Carver at the Tuskegee Institute, Alabama, during the last forty years, plans have been completed to establish the Carver Creative Research Laboratories to carry on the work on farm products that has been conducted by him at the institute. A. W. Curtis, Jr., assistant of Dr. Carver at the Tuskegee Institute, is seeking an endowment fund of $1,354,290 for the laboratories, the object of which is to coordinate the experiments now being conducted under Dr. Carver's supervision at Tuskegee and to disseminate the findings to farmers everywhere.

FRANK B. O'CONNELL, secretary of the Nebraska Game Commission, was elected president of the International Association of Fish and Game Commissioners on August 25 at the close of the recent annual meeting in Mexico. Next year's convention will be held jointly with that of the American Fisheries Society at Asheville, N. C.

THE appointment of Dr. William de B. MacNider, Kenan research professor of pharmacology, as dean of the Medical School of the University of North Carolina, was recently announced in SCIENCE. Dr. MacNider retains his research professorship. Other appointments include: Dr. W. Reece Berryhill, physician-in-chief to the university infirmary and associate professor of medicine, assistant dean; Dr. James C. Andrews, professor of biological chemistry and head of the department; Granvil C. Kyker, instructor in biochemistry; Dr. Harold W. Brown, professor of public health; Dr. Russell H. Holman, assistant professor of pathology; J. Gilmer Mebane, student research assistant in pathology; Dr. Warren S. Hammond, instructor in anatomy; Dr. Frank N. Low, instructor in anatomy. As a result of the recent appropriation by the state legislature and an additional Public Works Administration grant from the Federal Government, the university will erect on an appropriate site, at the cost of $400,000, a building for the use of the School of Medicine and for the Division of Public Health.

DR. DWIGHT O'HARA, professor of preventive medicine at the Medical School of Tufts College, has been appointed to the newly established position of vice dean. He will supervise clinical instruction during the third and fourth years.

DR. WILBERT J. HUFF, chief chemist in charge of the division for explosives of the U. S. Bureau of Mines, previously head of the department of gas engineering of the Johns Hopkins University, has been appointed head of the new department of chemical engineering at the University of Maryland. This department will work in close cooperation with the new laboratory of the U. S. Bureau of Mines on the grounds of the university.

DR. F. B. SMITH, of the Iowa State College, has been appointed professor of soils at the University of Florida and soil microbiologist in the Agricultural Experiment Station. Dr. Edwin A. Ziegler has been appointed professor of forest economics and P. W. Fraser and James W. Miller, Jr., assistant professors of forestry.

DR. JOHN HOWARD FERGUSON, associate professor of physiology and pharmacology in the School of Medicine of the University of Alabama, has been appointed associate professor in the School of Medicine of the University of Michigan.

DR. LORUS J. MILNE, formerly instructor in biology at Harvard University, has been appointed adjunct professor of biology at Randolph-Macon Woman's College, Lynchburg, Va.

COLUMBUS O'D. ISELIN, assistant curator of oceanography at Harvard University, has been promoted to be assistant professor of physical oceanography.

PROFESSOR E. U. CONDON has leave of absence from Princeton University to join the research staff of the Westinghouse Research Laboratories at East Pittsburgh in connection with plans for extending the program in fundamental research there.

DR. OTIS W. CALDWELL, professor emeritus at Columbia University and general secretary of the American Association for the Advancement of Science, will be visiting professor at Atlanta University, Georgia, during the academic year 1937–1938, but will continue certain duties as general secretary of the American Association for the Advancement of Science. Atlanta University includes several correlated units for Negro education. These units are Spelman College for women, Morehouse College for men, laboratory schools from nursery to senior high school, and several graduate divisions. Also there are cooperative relations with other near-by institutions. His regular address from September 15 to June 1, 1938, will be: Administrative Building, Atlanta University, Atlanta, Georgia.

AT the Iowa State College, leave of absence has been given to Dr. A. E. Brandt, assistant professor of mathematics and statistics, and to Dr. S. M. Dietz, professor of plant pathology. Dr. Brandt has accepted a six-months appointment as senior mathematical statistical analyst of the division of research of the Soil Conservation Service, Washington, D. C. He will act

as general consultant, review all the mathematical and statistical contents of divisional publications and will assist in designing new experiments. Dr. Dietz, for eleven years a member of the plant pathology staff, will become temporary head of the department of plant pathology at the State College of Washington, where he will take the place of Dr. F. D. Heald, head of the department, who has been granted a leave of absence.

Professor John Phelan, chairman of the department of sociology and anthropology at Carleton College, has leave of absence for the coming college year. He will spend fifteen months in the observation and study of juvenile delinquency, public housing and consumers' cooperatives in the main European countries.

Dr. Clarence E. Irion, who has been a research chemist at the Battelle Memorial Institute in Columbus, Ohio, since its organization in 1927, has resigned to join the scientific research staff of the General Printing Ink Corporation, New York.

Dr. Franklin G. Ebaugh, professor of psychiatry in the School of Medicine of the University of Colorado, Denver, is conducting a course in mental hygiene at the University of Hawaii during the summer and is making a survey of mental hygiene problems in Honolulu under the auspices of the chamber of commerce. It is planned to establish a psychiatric clinic.

Edgar B. Calvert, chief of the forecast division of the U. S. Weather Bureau, and Delbert M. Little, chief of the aerological division, have been designated advisers to the International Technical Aviation Conference to be held at Lima, Peru, from September 16 to 23. Meteorological problems, especially those bearing on intercontinental aviation and communication relations between the Pan American nations, will be discussed at the conference.

Dr. William Beebe returned to New York on September 3 after completing his twenty-fifth expedition to study the marine life of Bermuda, under the auspices of the New York Zoological Society.

An Associated Press dispatch reports that fifty members of the Arctic expedition led by Dr. Lauge Koch abandoned its ship on August 29 after it was menaced by pack ice off eastern Greenland. The party includes twenty scientific men of various nationalities. They are reported to be making their way to Scoresby Sound.

A special cable to *The New York Times* from Panama dated August 28 reports that the Government of the Republic has granted the Carnegie Institution permission to export for study parts of skeletons found in recent excavations at Uaxactun and Kaminal. The shipment consists of thirty-nine hands and six skulls, one of which contains teeth filled by a prehistoric dentist. Permission also was granted to export 359 pieces of pottery, of which the U. S. National Museum has duplicates. The skeletons must be returned to Guatemala within six months.

Applications are invited for the chair of anatomy at the University of Melbourne at a salary of $5,500 per annum.

The Indianapolis City Hospital has received a gift of $100,000 from Edwin L. Patrick, president and secretary of the C. B. Cones and Son Manufacturing Company, to establish and endow a cancer clinic. The clinic will be named Patrick Hall in memory of his wife, the late Katheryn Cones Patrick, and her father and mother.

The Wild Life Restoration Act was signed on September 2 by President Roosevelt, authorizing annual distribution of some $2,760,000 to states which agree to cooperate. According to a summary of the bill given in *The New York Times* each state is required to adopt assenting legislation, but any governor, until after adjournment of the next regular legislative session, may give his state's assent by executive order. The measure does not levy new taxes, but provides for distribution of existing taxes on sportsmen's equipment to the various states on the basis of area and number of hunting licenses sold. States and the federal government, through the Secretary of Agriculture, are to cooperate in using the money for wild life conservation projects. No state may receive more than $150,000 a year under the act, and a minimum of $15,000 is provided for any state which will set aside $5,000 for the work. The states are to set aside, with these maximum and minimum exceptions, one third as much in state funds as they receive from the federal government. Two states, Pennsylvania and New York, would receive more than $150,000 except for the legislative limitation, and three others, Connecticut, Delaware and Rhode Island, would receive less than the $15,000 minimum.

The *Journal* of the American Medical Association reports that a "Roentgen Bureau" has been established at Munich by the German Roentgen Society. It is planned to build up a library collection, which will cover the entire field of radiology and to house much supplementary material and a card catalogue of works on general and specific topics related to radiology. Provision has also been made for a museum collection of radiologic and kindred apparatus to illustrate the historical development of the field. The building up and completion of the collections is in charge of the recently created Roentgen Memorial Foundation. All the work of acquisition and cataloguing will be supervised by this body. The honorary officers of both library and museum are appointed by the head of the German Roentgen Society.

DISCUSSION

THE PROPOSED REORGANIZATION OF FEDERAL DEPARTMENTS

THINGS are moving rapidly in Washington in a way which may throw immeasurable quantities of sand into the federal conservation machinery. One thing is a bill (S. 2970) which the Senate Select Committee on Government Organization has just reported out which would give the President wide authority for three years to make transfers among the government bureaus, and which also would change the name of the Interior Department to the Department of Conservation. While hearings were in progress on this bill, another one (H. R. 8202) was passed by the House. The House bill omits the provision for rechristening the Interior Department, but gives the President authority during the next two years to make extensive switches within the framework of the governmental administrative structure.

These proposed bits of legislation have a special significance to farmers, foresters and other conservationists, because of their hook-up, actual or potential, with the reports submitted to the President last winter by a committee headed by Louis Brownlow which made a study of the federal organization and suggested sweeping changes. Among the recommendations was that for renaming the Department of the Interior the Department of Conservation.

Under the Brownlow formula, the Department of Conservation, among other things, would administer public lands . . . and reservations. This, of course, could readily mean a transfer to the Department of Conservation, were it created, of bureaus now in the Department of Agriculture, such as the Forest Service, which administers the National Forests, and the Biological Survey, which administers a considerable number of federal wildlife refuges. A case could easily be made by proponents of the Department of Conservation idea to transfer at least part of the Soil Conservation Service—perhaps all of it.

The possibilities in this direction have led to numerous and vehement protests to Congress by all the major farm organizations in the country, by wildlife interests, by the American Forestry Association, the Society of American Foresters, the Association of State Foresters, and many others. These protests have pointed out that the integrity and unity of the whole agricultural policy and program is menaced; that administration of the National Forests, for example, is in chief measure an agricultural function, because it involves raising successive crops of trees which, as scientists well know, involves the same basic biological principles as the raising of any other crop. The same thing is true of the administration of the range resource in the National Forests. The Soil Conservation Service job is wholly agricultural. Any reallocation of governmental functions in this field on the basis of who owns the land on which crops of timber or grass or other living things are being grown would be wholly illogical. In the case of the Forest Service, it would mean breaking it down and having one Forest Service in the Department of Conservation to administer the National Forests and another, presumably to be left in the Department of Agriculture, to administer the federal activity of trying to bring forestry to nearly 300 million acres of privately owned commercial timberlands and, with the Extension Service, to handle the forestry work relating to 150 million acres of farm woodlands. Presumably forest research would stay in Agriculture, so the foresters administering the National Forests under the Department of Conservation would be cut off from the continuous working contact with research, which is so essential to the proper scientifically supported administration of the forests.

The same illogical split would result in the activities of the Biological Survey. There is little doubt that the proponents of the Department of Conservation idea also have their eyes on the Soil Conservation Service. In other words, they want to get into the proposed Department of Conservation all the Federal activities in the field of natural resource conservation.

It is painfully obvious how wide open this would tear the Department of Agriculture and the unity of the handling of a conservation field which is strictly agricultural in its character. It is reversing the process which began in 1905 when the national forests were transferred from the Department of the Interior to the Department of Agriculture at the instigation of Theodore Roosevelt and the then Secretary of the Interior in order that the national forests might receive the technical administration handled in Agriculture, but wholly lacking in Interior. This process was continued under the present administration when the Soil Conservation Service, which was started as an emergency agency under PWA Administrator Ickes, was transferred by President Franklin Roosevelt to the Department of Agriculture, and when he later put resettlement under Agriculture. The Soil Conservation Service simply had to be brought into the Agriculture fold because its purely agricultural functions exercised elsewhere were resulting in the building up of a second Department of Agriculture in the field. This duplication of the Department of Agriculture would be the inevitable result of any reorganization in the conservation field along the Brownlow Committee lines.

Whether or not a Department of Conservation is created, various bureaus in the Department of Agriculture could be shifted to Interior or elsewhere, with the same disruptive effect on the cohesiveness of the

agricultural program. Until Congress once for all directs that agricultural functions shall be retained in the Department of Agriculture and those now elsewhere placed therein, the threat of dismemberment will continue to hang over the agricultural group of Federal activities.

One more thought—it is, of course, obvious upon reflection that there is a fallacy in the idea that any one department can encompass a major part of the governmental activities in the field of conservation and could possibly be entitled to that name. Conservation as a purpose is achieved by innumerable governmental activities quite unrelated. It would be almost as logical to suggest a department of thrift as to propose a Department of Conservation with the implication that it could be all-inclusive in this field.

No action was taken in the Senate on either bill, but the legislation will undoubtedly be pushed at the beginning of the next session.

Another baleful feature is in the Senate bill—the authority for the President, with Senate concurrence, to hereafter appoint bureau chiefs when the position is determined by the President to be policy-making in character. This opens the door wide to the spoils system in these important positions, many of which are now under civil service, and so offer a goal to ambitious and qualified scientists which, under the reorganization bill, would be denied them except by political preferment.

Correspondent

A UNIQUE DOCUMENT

The following document is probably unique in the history of science. I have translated it from Issue 1, Volume XIV of the *Astronomical Journal of the Soviet Union*, where it appears in front of page 1.

Otto Struve

Yerkes Observatory,
Williams Bay, Wis.

"We Demand Ruthless Punishment for the Vile Betrayers of our Great Country.

"The scientific workers of the Soviet Union have learned with a feeling of revolt and great wrath of the monstrous crimes perpetrated by the contemptible Trotzkysts—those heinous traitors of their country, whose treacherous activities are at present being unraveled by the soviet court.

"Having sold themselves to the fascists, having come to an agreement with the diplomats and general staffs of some aggressive imperialistic states, this despicable gang of human degenerates, of servants of fascistic cannibals, being led by the agent of the Gestapo, the bandit Trotzky, was selling our socialistic country and its riches to the worst enemies of human progress.

"The abominable traitors were organizing attempts to murder the best men of the present time, the leaders of the first socialistic state in the world; they were organizing monstrous injuries to the socialistic factories, mines and railroads; they were murdering our heroes, the stakhanovtzi, our glorious and brave red soldiers; they were stealing from the soviet state, in order to maintain a pack of Trotzkysts and in order to finance their criminal activities.

"In their attempt to undermine the military and economic strength of the great land of socialism, this despised gang of restorers of capitalism was trying to make it easier for the fascists to carry out their plans for seizing the territory of the SSSR and for the restoration of capitalism. They were dreaming of returning the power in our country to the capitalists, of liquidating the kolkhosi and the sovkhosi, of enslaving the soviet people, of creating unemployment, poverty and famine; they were trying to deprive the soviet people of its great conquests, which are written into the Stalin Constitution.

"We demand from our soviet courts merciless punishment for the infamous traitors! We demand the annihilation of the despicable degenerates!

"We also demand a complete investigation into the participation of the right-wing renegades—Bukharin, Rijkov, Uglanov—in the criminal activities of the Trotzkysts, and we demand that they be called to the severest accountability.

"The scientific workers will give all their knowledge and strength for the even more rapid growth and flourishing of our great socialistic country, for the increased strength of the Red Army—that faithful guardian of the soviet frontiers.

"The scientific workers, together with all the soviet people, will unite still closer around the communistic party, its Central Committee and the beloved leader and friend, comrade Stalin."

Signed by the President of the Academy of Sciences, V. Komaroff, and by eighteen members of the Academy and professors.

(Izvestia, January 27, 1937.)

A MINNESOTA KITCHEN MIDDEN WITH FOSSIL BISON[1]

From July 12 to August 25 the University of Minnesota has been digging an archeological deposit in a bog in Itasca State Park, the seat of the source of the Mississippi River. In cooperation with the State Conservation Commission and the Federal Government whose financing provided adequate labor, the Department of Anthropology has spent the major part of its 1937 field Summer Session digging the newly discovered bog deposit. To date the work has rescued some two thousand knife-marked, food-refuse animal bones, with bone and stone artifacts.

The bone bed is a marly layer which lies on the old lake bottom of an earlier southward extension of the present west branch of Lake Itasca. That old lake

[1] Preliminary notice.

bottom lies 6 to 8 feet below the present water table as exposed in Nicollet Creek, which feeds the west branch of Itasca. The bone bed varies in thickness up to about 4.5 feet. It lies from about 3.5 to 9 feet beneath the present surface of the bog, which consists of living grasses, sedges and marsh weeds growing above successive layers of massive peat, sandy peat, marly sand and more consistent marl having abundant snail shells. Immediately below this stratified bog is the old lake bottom of boulders, cobbles, gravel and sand.

The bones are well preserved and some of them, even as washed in the field, are distinctly seen to be mineralized. Their surfaces are knife-marked to an unusual degree. None have been noted bearing tooth marks of carnivores.

Among the bones rescued and identified in the field are those of bison (*Bison occidentalis*)[2] represented by a skull with horn cores, long bones, jaws, vertebrae, cartilage and fragmentary identifiable pieces. There are bones of elk, represented by several jaws, vertebrae and long bones—two of which have been modified for artifacts. There are a few bones of bear, caribou and, probably, moose and wolf. Besides, there are numerous bones of fish and carapace of at least two species of turtles.

Five stone artifacts have also been recovered from the bone bed, three of which are flake specimens with retouching, while the fourth and fifth are chopping tools chipped to rough, parallel faces, and retouched on working edges.

ALBERT ERNEST JENKS
UNIVERSITY OF MINNESOTA

A FIRE-BALL

THE electrical phenomenon known as a "fire-ball" is rather a rare occurrence. Therefore one that I saw at Fitzwilliam, New Hampshire, at 5 P.M. on August 10 may be worthy of record. I was seated on a second story porch enclosed with glass watching the storm. A radio aerial extends from a distant tree to a point on the side of the house some distance from the porch. Coincident with a crash of thunder, the fire-ball appeared. I can not say that it followed the wire or came from the sky. It just came out of space and seemed to move directly toward the window and then fell as though to enter the cellar of the house. It was a round, bronze, glistening ball with gleaming rays shooting from the top and sides; by its beauty and brilliance reminding one of an ornament at the top of a Christmas tree. Such was my fleeting sight of a fire-ball. Probably at the same instant, all electric fuses in the house blew out with unusual violence.

MARY ETHEL HUNNEMAN

SPECIAL ARTICLES

CATATONIA PRODUCED BY THE INTRODUCTION OF HEAVY WATER INTO THE CEREBROSPINAL FLUID

THE mammalian central nervous system is known to react to heavy water (deuterium oxide). Barbour and Trace[1] described in mice hyperexcitability succeeded by depression, when the animal's body water was about one third saturated with deuterium. Hansen and Rustung[2] in more acute experiments, with several cc of deuterium oxide at one time, described depression, catatonia and rolling movements. We[3] have seen the same effects, as well as potentiation of the convulsant action of ergotoxine.

In larger animals we have now achieved concentrations effective for the nervous system by injections directly into the cerebrospinal fluid, whence, due to slow drainage, the deuterium is dissipated much more slowly than from other sites.

Over the parietal brain cortex of seven rats we have introduced one or two tenths of a cc of deuterium oxide through a previously made trephine hole. The uniform result was catatonia (catalepsy). This state developed within a few minutes, lasting usually for many hours, sometimes being evident on the next day. Ultimately complete recovery occurred in all animals. Other central effects were observed in some; for example, the eyeballs receded in three rats, two showed ataxia and one showed hyperexcitability, with jumping. Two adult cats were also given deuterium oxide, by lumbar puncture, with the successful production of catatonia in both cases. This was accomplished in a female cat of three kilos by withdrawal of 0.4 cc spinal fluid, followed by injection of 0.7 cc deuterium oxide, 99.5 per cent., and in a male four-kilo cat, from which 1.5 cc fluid was removed and 2.8 cc deuterium oxide injected without excess pressure.

Abundant evidence has accumulated in this laboratory[4] of a variety of pharmacological actions occurring when 20 per cent. heavy water is in contact with body cells. In the catatonia experiments a like degree of saturation must have been attained in parts of the

[2] Identified by Dr. Samuel Eddy, associate professor of zoology, University of Minnesota.

[1] H. G. Barbour and Jane Trace, *Jour. Pharm. and Exp. Therap.*, 58: 460, 1936.

[2] K. Hansen and E. Rustung, *Klin. Wochenschr.*, 14: 1489, 1935.

[3] H. G. Barbour and J. B. Herrmann, *Jour. Pharm. and Exp. Therap.*, 1937. (In press.)

[4] H. G. Barbour, *Yale Jour. Biol. and Med.*, 9: 551, 1937.

central nervous system immediately adjacent to the cerebro-spinal fluid.

Julian B. Herrmann
Henry G. Barbour
Laboratory of Pharmacology and Toxicology
Yale University

ATROPHY OF THE ADRENAL CORTEX OF THE RAT PRODUCED BY THE ADMINISTRATION OF LARGE AMOUNTS OF CORTIN

It has been observed by Wyman and tum Suden[1] and by Ingle and Higgins[2] that transplants of adrenal glands do not regenerate in the presence of one intact gland. In unpublished studies Ingle and Higgins have noted that the regeneration of the enucleated adrenal does not take place in the presence of one intact adrenal, although the regeneration is consistently rapid when there is a "deficiency" in the activity of the adrenal cortex. Ingle and Kendall[3] found that the oral administration of large amounts of cortin suppressed the regeneration of enucleated adrenals. In addition to these results we have now found that the administration of large amounts of cortin to the normal rat will produce atrophy of the cortex of the adrenal and that this atrophy can be prevented by the simultaneous administration of a fraction of anterior pituitary extract which has high adrenotropic activity.

Male rats of the Wistar strain with body weight of 180 to 190 gm were matched in groups of three. One rat of each group received 10 cc of cortin daily in its drinking water; the second rat received 10 cc of cortin orally, and, in addition, 1 cc of an adrenotropic preparation[4] was given daily by intraperitoneal injection; the third rat was untreated. Six groups of rats were studied. At the end of seven days the adrenal glands were removed, weighed and examined histologically. The data on weights of the adrenals are summarized in Table 1.

TABLE 1
Effect of Administration of Cortin on Adrenal Weights (Both Glands)

Treatment	Number of rats	Average, mg	Range, mg
Cortin only	6	14.7	14–16
Cortin plus adrenotropic preparation	6	25.3	24–29
Untreated	6	27.7	27–30

Our results indicate that the anterior pituitary or some mechanism which controls its activity is sensitive to variations in the amount of cortin in the body fluids or to physiologic functions influenced by cortin and that the changes in the adrenal cortex are mediated by changes in the output of the adrenotropic principle from the pituitary. When the physiologic requirements for cortin are increased there is an increase in the output of the adrenotropic principle, and when cortin is present in the body fluids in excess of physiologic requirements the output of adrenotropic secretions from the pituitary is suppressed. The experimental results and deductions of a number of other investigators support this hypothesis, and at the present time we are not aware of any contrary evidence.

D. J. Ingle
E. C. Kendall
The Mayo Foundation
Rochester, Minn.

[1] L. C. Wyman and Caroline tum Suden, *Endocrinology*, 21: 523, 1937.
[2] D. J. Ingle and G. M. Higgins, *Proc. Staff Meet. Mayo Clinic*, 12: 204–205, March 31, 1937.
[3] D. J. Ingle and E. C. Kendall, *Proc. Staff Meet. Mayo Clinic* 12: 505, Aug. 11, 1937.
[4] This fraction was prepared by the method of Moon and was supplied to us through the courtesy of Dr. O. Kamm, Detroit, Michigan.

THE SPARING ACTION OF LACTOFLAVIN ON VITAMIN B_1

The sparing of vitamin B_1 by feeding high levels of certain substances was demonstrated several years ago by Evans and Lepkovsky,[1] at which time they attributed the beneficial effect of autoclaved yeast to the presence of vitamin G or B_2. Since then vitamin B_2 has been identified as lactoflavin and its availability in crystalline form has revived interest in this important problem.

The data presented here were obtained from three groups of 28-day albino rats whose mothers had been reared from weaning on diets adequate in all respects for growth and reproduction and varying only in their content of lactoflavin. The 1E grade of lactoflavin of the Borden Company was used, and, while not in crystalline state, it had tested free of vitamin B_1 and other water-soluble vitamins. The lactoflavin was added to the basal diet in such quantities that the final three diets contained approximately 1, 2 and 3 Bourquin-Sherman[2] units per gram, which for convenience will be designated here as diets 1, 2 and 3. In the experience of the author 2.9 γ of crystalline lactoflavin has been equivalent to 1 Bourquin-Sherman unit.

The 28-day young, whose previous dietary had been similar except for the lactoflavin content of the maternal died, were placed upon the Chase and Sherman vitamin B_1 deficient diet[3] and their weight recorded weekly until death. Three males and three females of typical weight were selected from each of the three diets.

[1] H. M. Evans, S. Lepkovsky and E. A. Murphy, *Jour. Biol. Chem.*, 108: 429, 1934.
[2] A. Bourquin and H. C. Sherman, *Jour. Am. Chem. Soc.*, 53: 3501, 1931.
[3] E. F. Chase and H. C. Sherman, *Jour. Am. Chem. Soc.*, 53: 3506, 1931.

BEHAVIOR OF LACTOFLAVIN FED RATS ON VITAMIN B_1 DEFICIENT DIET

	Males			Females		
Maternal diet	1	2	3	1	2	3
Initial weight—gm.	44	57	51	44	43	48
Final weight—gm	39	41	43	34	36	36
Maximum gain—gm (2 weeks)	15	21	22	15	20	17
Days of survival	31.6	35.0	37.6	34.6	37.6	45.3

The growth and length of survival during the period of vitamin B_1 deficiency was directly dependent on the lactoflavin content of the maternal diet. While the number of cases was small, the regularity with which the age at death depended on the previous lactoflavin intake leaves little room for doubt that this vitamin, in some as yet undetermined way, spared the vitamin B_1 reserves of the body. These results are in agreement with those of Evans and Lepkovsky,[4] who fed autoclaved yeast as the source of vitamin B_2 at different levels during the experimental period.

The sparing action has been found so far to be specific only for vitamin B_1. A similar group of 28-day rats when fed the Sherman-Spohn diet,[5] deficient in all the water-soluble vitamins, showed no such regularity of survival or growth response. In this case the first limiting factor of the multiple deficiency was probably vitamin B_6, since the growth was poorer than on either a vitamin B_1 or lactoflavin deficient diet.

This sparing action is being investigated further. Both vitamins are required for normal carbohydrate metabolism, though the sites of their influence are apparently widely separated; and both vitamins contain a pyrimidine nucleus. The possibility that, through a similarity of chemical structure and physiological action, the two vitamins can substitute for each other for a short space of time in an emergency and thus in turn be spared opens an interesting field of study.

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PARTHENOCARPIC FRUITS INDUCED BY SPRAYING WITH GROWTH-PROMOTING CHEMICALS

PARTHENOCARPY, a not uncommon phenomenon, occurs in some plants without the aid of an outside stimulus and has been artificially induced in other plants by a number of means. Gustafson[1] was able to cause fruit development in several species which do not normally exhibit parthenocarpy, by dabbing lanolin mixtures of growth-promoting chemicals on the styles, which were first shortened by cutting them off close to the ovary. Hagemann[2] also reports parthenocarpic fruits in Gladiolus obtained with indoleacetic acid in lanolin. Recently, the authors produced parthenocarpy by spraying blossoms with dilute aqueous solutions of growth substances and without first altering the floral organs.

Of the various plants experimented with, the most notable success was encountered with the native American holly, *Ilex opaca*. As is well known, this plant is dioecious and is therefore particularly well adapted for tests of this kind, since young pistillate flowered plants involve no emasculation and can easily be isolated from any possible chance of pollination. Previous attempts to induce fruit setting in this species with pollens of miscellaneous unrelated species have resulted in complete failure. The application of *Ilex opaca* pollen, however, normally results in 100 per cent. fruit setting.

The holly plants used were propagated by cuttings from a bearing tree during the summer of 1936 and were well supplied with flower buds which had differentiated before the cuttings were removed from the parent tree. Planted in small pots, these miniature holly trees put forth vigorous new growth and blossomed in May, 1937.

When the plants were in full bloom the flowers were sprayed with four different growth substances, namely: indoleacetic, indolebutyric, indolepropionic and naphthaleneacetic acids in aqueous solutions ranging in concentrations from 1:1000 to 1:1,000,000. Although each of the four substances induced parthenocarpy, naphthaleneacetic acid was by far the most potent, causing all the flowers to set fruit when used in .006 per cent. concentration. Even a solution of 1 part per million induced 10 per cent. of the flowers to set fruit. Acetic acid in comparable concentrations and also in considerably stronger ranges than used with the above-mentioned growth substances produced no parthenocarpic effect. The details of the experiments showing the relative effectiveness of these four chemicals in producing parthenocarpy will be presented at a later date.

At the present writing the parthenocarpic holly fruits compared with those obtained by pollination have developed in an apparently normal fashion and have reached mature size.

Some fruits were also set on the holly by watering the soil around the young plants while in bloom with a relatively strong solution (.15 per cent.) of indoleacetic acid. Sufficient solution was added in each of two successive waterings so that considerable drainage from the pots ensued. Strangely enough, the concentration of .15 per cent. produced no apparent injury and no epinasty. Plants watered with a .02 per cent. solution of indoleacetic acid did not set any fruits.

In addition to holly, individual potted plants of a pistillate strawberry selection were sprayed with in-

[4] *Loc. cit.*

[5] H. C. Sherman and A. Spohn, *Jour. Am. Chem. Soc.*, 45: 2719, 1923.

[1] F. G. Gustafson, *Proc. Nat. Acad. Sci.*, 22: 628–636, Nov., 1936.

[2] P. Hagemann, *Gartenbauwiss*, 11: 144–150, April, 1937.

doleacetic acid in concentrations of .1, .05, .025, .01 and .005 per cent., respectively. In all concentrations there was apparently normal development of the achenes which, upon subsequent examination, proved to be empty seed coats. With the .05 and .1 per cent. concentrations a number of the receptacles or fleshy portions developed and ripened into apparently normal fruits. In the lower concentrations, however, the receptacles made only an initial growth, which soon stopped. Unsprayed flowers made no development of receptacle or achenes.

Trees of the Starking apple, a self-sterile variety, were protected from cross-pollination and, when in bloom, sprayed with indoleacetic acid in concentrations ranging from .01 to .06 per cent., but no fruits developed. Likewise, the Brighton grape, which is self-unfruitful, failed to respond to naphthaleneacetic acid in concentrations ranging from .0005 to .01 per cent. These concentrations were of course arbitrarily selected and, having failed, there was no opportunity to try other concentrations, since the flowering period had passed. Perhaps these plants might also have responded if the proper concentration had been applied. In the case of the grape, which has a very short style, as has also the holly, it was thought that the stimulus should have little difficulty in reaching the ovary.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE PRESERVATION OF BIOLOGICAL SPECIMENS BY MEANS OF TRANSPARENT PLASTICS

SOME months ago it occurred to the writer that the transparent type of plastic more or less typified by polymerized methyl methacrylate would make a suitable medium for the mounting and preservation of specimens of all descriptions. Some botanical specimens, such as leaves, flowers, small plants and petals, and biological specimens, such as a chicken heart and various types of insects—bees, beetles and lately butterflies—were consequently mounted in this medium. The results have exceeded expectations. There is no apparent deterioration, even though some specimens have been exposed to full sunlight for several weeks.

The method lends itself to easy manipulation, and the resultant product is a hard, water-clear case for the article which is to be preserved. This case or covering can be made in any reasonable thickness and shape. There is no danger of breakage and any face may be ground and polished or sawn with ease. This property facilitates the preparation of thin specimens. Once hardened, there is no softening of the polymer within the temperature ranges one is likely to encounter. Inorganic materials susceptible to attack by vapors or humidity may likewise be preserved intact as well as fragile specimens of archeological interest.

The primary advantage of this medium rests in the ease of preparation, in its superior physical and optical properties, and in its capacity to preserve material which would otherwise deteriorate.

Not only may different plastic materials be used, but the manipulative procedure may be varied over a considerable range. This procedure is as follows: Methyl methacrylate monomer is first given a preliminary polymerization by heating to approximately 80° C. This increases the viscosity of the liquid from that of a relatively thin liquid to one that approximates the viscosity of ethylene glycol or glycerine. The degree of polymerization desirable at this point depends on the specimen. The greater the rapid polymerization under heat the less time necessary to complete the reaction in the cold. However, if the solution is too viscous, then the elimination of bubbles becomes more difficult. The specimen which is to be preserved is first treated briefly with a dilute solution of formaldehyde—if it is an organic specimen, although on occasion this step may be omitted. It is then dried rapidly in vacuum and immersed in the partially polymerized methyl methacrylate, taking care to remove any bubbles. This may be facilitated either by immersion in vacuum or evacuation of the air after immersion.

The final solidification or complete polymerization may be hastened either by exposure of the liquid containing the specimen to the radiation from a glass mercury arc, sunlight or other suitable source of light or by the addition of a small amount of benzoyl peroxide, sulfur trioxide or other suitable agents to the liquid. This will cause the complete polymerization in not more than a few hours, the exact time depending on the amount of initial polymerization. This final step can be carried out at a temperature sufficiently low so that there is no destruction of the specimens.

The vessel containing the methyl methacrylate may be of any desired shape, thus permitting any orientation of the specimen in the final solid. If it is desirable to have only a thin layer of the polymer over a cross-section of the specimen for microscopic examination, the specimen may be first totally immersed but after solidification a section sawn through the specimen at any point, thus exposing anew any desired face.

Over this face may be poured a thin layer of the partially polymerized methyl methacrylate, which will solidify on the already formed solid without appreciable demarkation. This work is being continued.

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A PARAFFIN BLOCK TRIMMER[1]

THE description of a paraffin block trimmer is offered because of its usefulness, inexpensiveness and simplicity of construction. An old discarded Bausch and Lomb dissecting microscope stand, with lens arm and glass stage removed, and a regular microtome blade were utilized in constructing the trimmer. The microtome blade can be inserted and removed by merely tightening and loosening two wing nuts.

A hard tough wood was used in the trimmer. The following procedure is suggested for constructing it. Cut out a piece $2\frac{1}{4}''$ ($2\frac{1}{8}''$ plus width of saw used) $\times 1\frac{5}{8}'' \times 6''$. If several are to be made increase the length accordingly. Drill holes for the four wood screws (a) on the $1\frac{5}{8}''$ side, $\frac{3}{8}''$ from one edge. These screws clamp block A and B to the rack. Rip the block so as to obtain block A, $\frac{3}{4}''$ thick, and block B, $1\frac{3}{8}''$ thick. Cut the groove for the toothed part of the rack only in the middle of block A. Make a V-shaped groove for the triangular-shaped rack in block B. On the opposite side from the V-shaped groove cut out an area $\frac{1}{4}'' \times 1\frac{1}{2}''$. Cut the inclined plane, on which the microtome blade rests, at 30° with the horizontal

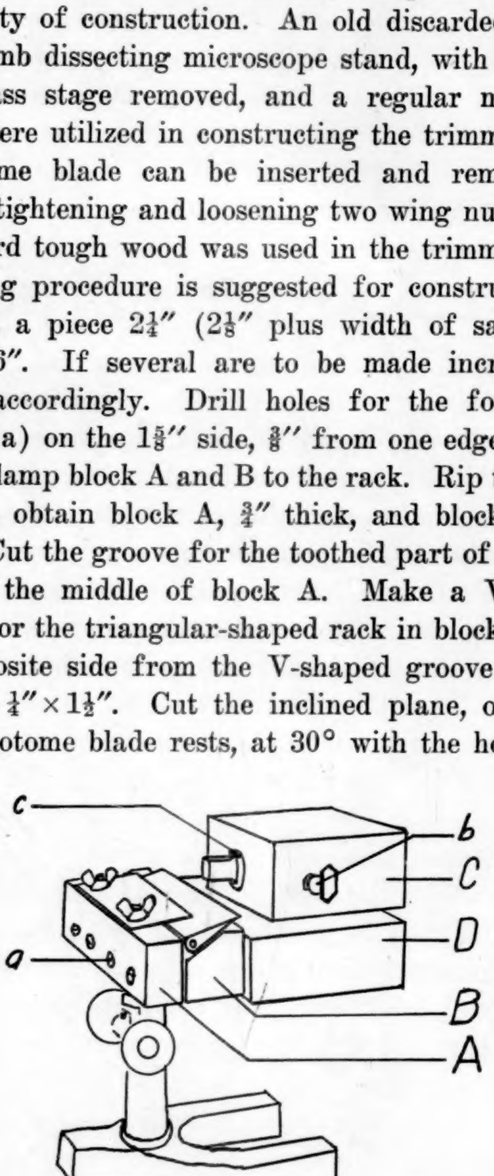

FIG. 1.

plane, beginning the cut at the corner. The finished block B should measure about 29/32″ on the side that clamps to A and 1 7/16″ on the opposite side. Finished block A measures $\frac{3}{4}'' \times 1\ 5/16''$. Block C measures $1\frac{5}{8}'' \times 3\frac{1}{4}'' \times 3\frac{1}{2}''$. A $\frac{1}{4}''$ stove bolt (b), as a set-screw, holds the object block tight in the block. Block D measures $1\frac{3}{8}'' \times 3\frac{1}{2}'' \times 6''$. Cut out an area $\frac{1}{4}'' \times 1\frac{1}{2}''$ to coincide with the same size opening in block B. These two combined openings ($\frac{1}{2}'' \times 1\frac{1}{2}''$) allow trimmed-off paraffin to fall below.

This blade holder was constructed for use with a Spencer No. 942 blade. If a smaller blade is used the dimensions should be changed so that when block C is pushed up against block B, in the process of trimming the paraffin block, there will be about $\frac{1}{8}''$ clearance between block C and the cutting edge of the microtome blade. This obviously is for protecting the cutting edge.

The microtome blade is held in place by a piece of sheet metal $1\frac{1}{4}'' \times 4''$ fastened to block A by means of two stove bolts with wing nuts.

The trimming of the paraffin block is accomplished in the following manner: Block C, with the object block (c) held securely in a $\frac{3}{4}''$ hole drilled for that purpose, is pushed up repeatedly against block B. The height of the microtome blade is regulated by turning the pinion. It is suggested that the cutting edges at each end of the blade, which can not be used for sectioning, be used for trimming the block.

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[1] Contribution No. 183, Department of Zoology.

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